R E P O R T R E S U M E S

ED 012 508 EA 000 691

SOME RECENT IDEAS IN RESEARCH METHODOLOGY--FACET DESIGN AND THEORY OF DATA.

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PUB DATE 65

EDRS PRICE MF-$0.25 HC-$1.76 44P.

DESCRIPTORS- *RESEARCH METHODOLOGY, *THEORIES, *DATA, *DATA COLLECTION, *DATA ANALYSIS, EDUCATIONAL RESEARCH, EUGENE

FACET DESIGN, AS ORIGINATED BY LOUIS GUTTMAN, IS A METHOD OF SYSTEMATICALLY ORDERING A PROBLEM FOR RESEARCH. FACET ANALYSIS ENABLES THE VALIDITY OF AN ASSESSMENT OF THE ORDERING PROCESS TO BE TESTED. THE LOGIC OF FACET DESIGN AND ANALYSIS IS BASED UPON SYSTEMATIC DELINEATION OF THE IMPORTANT VARIABLES PRIOR TO DATA COLLECTION AND THE EVALUATION OF THEIR EFFECT IN A SPECIFIC RESEARCH DOMAIN. THE AUTHOR CONSIDERS THE APPLICATION OF HIS DESCRIPTION OF FACET DESIGN AND ANALYSIS IN FOUR SPECIFIC RESEARCH CASES AND SHOWS, IN EACH CASE, HOW THE PROBLEM UNDER CONSIDERATION CAN BE SPECIFIED MORE PRECISELY, HOW RELEVANT HYPOTHESES EVOLVE FROM THE FACET DESIGN, AND HOW THE VALIDITY OF FACETS CAN BE COHERENTLY CHECKED. THE RESEARCH PROCESS CAN BE DIVIDED INTO FIVE PHASES--(1) CHOOSING THE DOMAIN OF INVESTIGATION, (2) RECORDING OBSERVATIONS MADE WITHIN THE DOMAIN, (3) CONVERTING OBSERVATIONS INTO DATA, (4) CLASSIFYING THE DATA, AND (5) SEEKING RELATIONSHIPS AMONG VARIABLES. THE THEORY OF DATA CONCERNS PHASES 3 AND 4. A SCHEME PROPOSED BY COOMBS IS CITED WHICH ENCOMPASSES ALL OF THE FACETS ENCOUNTERED WHEN OBSERVATIONS ARE CONVERTED INTO DATA AND DATA INTO VARIABLES. COOMBS PRESENTS A "SEARCHINGNESS STRUCTURE" WHICH ENABLES A RESEARCHER TO LAY OUT AN ENTIRE GRID OF METHODS FOR COLLECTING DATA. HIS CONCEPTUALIZATION OF THE FIELD CAN PROVIDE MEANS OF INVENTING NEW METHODS OF COLLECTING DATA AND OF CHOOSING APPROPRIATE WAYS TO ANALYZE THE GATHERED DATA. THIS DOCUMENT IS A REVISED VERSION OF A PAPER PRESENTED AT THE CONFERENCE ON NEW DIRECTIONS IN RESEARCH IN EDUCATIONAL ADMINISTRATION (UNIVERSITY OF OREGON, EUGENE, MARCH 30, 1965). THE EARLIER PAPER IS INCLUDED AS ED 010 221. (GB)

ED012508

Center for the
Advanced
Study of
Educational
Administration

UNIVERSITY OF OREGON
Eugene

EA 000 691

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A revised version of a paper presented at the
Conference on New Directions in Research in
Educational Administration

University of Oregon
Eugene, Oregon

March 30, 1965

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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The author wishes to acknowledge the support of the Center for the Advanced Study of Educational Administration during a portion of the time he devoted to writing this paper. CASEA is a national research and development center which was established at the University of Oregon under the provisions of the Cooperative Research Program of the United States Office of Education.

SOME RECENT IDEAS IN RESEARCH METHODOLOGY: FACET DESIGN AND THEORY OF DATA

Philip J. Runkel

The purpose of this paper is to describe very briefly a couple of particular ways of thinking about research methodology. My selection of these ways of thinking is purely arbitrary, but I have chosen these particular ideas because first, I consider them very powerful ideas and second, they are not yet being widely taught and are, therefore, not easy to come by. Not only do these ideas help those familiar with them to make comparisons and selections among the plethora of methods being used in current research, but in my opinion these ideas will come more and more to be used as tools by those who will be developing still further methods to replace those with which we have become dissatisfied.

Each of the two schemes of thought which I shall present is very simple in its basic structure, though very extensive and complicated in its implications. The first idea is that of facet design and analysis originated by Louis Guttman, director of the Israel Institute of Applied Social Research. Bobbs-Merrill will soon publish a preliminary edition of a book by Guttman about facet design and analysis, but until that book appears the only published information about this idea is to be found in scattered articles. The second idea is the theory of data of Clyde H. Coombs of the Psychology Department at the University of Michigan. Most of the structure so far worked out for this theory of data is now contained in a book which appeared in 1964. Obviously, only the briefest of introductions to each of these ideas can be contained in this paper. A bibliography which can be pursued if either of the ideas strike you as useful will be found at the end of the paper.

FACET DESIGN AND ANALYSIS

Facet design is a way of laying out a domain for research. Although it produces hypotheses, its special power as a tool resides in the fact that it enables one to specify the boundaries and structure of the entire domain of relevance within which one may wish to experiment. Facet analysis then enables one to test the validity of one's assessment of the entire domain before he invests great time and money in experiments upon portions of the domain. But I have fallen into rather abstract phrases. In order to turn to a more concrete way of speaking, let me take a couple of paragraphs to set the stage with a few familiar features of experimental design.

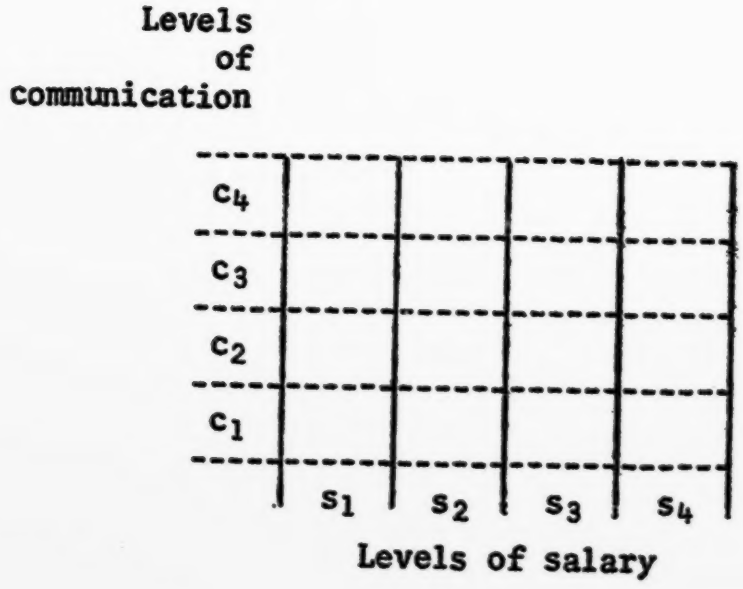
In designing an experiment, one of the most nagging problems is whether we have chosen (a) relevant variables to be allowed to vary and (b) relevant variables to be controlled. That is, our hypotheses typically take this form: under what conditions will values of a certain (dependent) variable be higher and under what conditions will the values be lower? For example, we might ask under what conditions teachers will stay longer in a school and under what conditions teachers will cut short their stay. We might feel that the amount of communication of some certain kind within the faculty would be related to length of service -- and we might, therefore, produce or look for schools in which there were conditions of low, medium, and high communication. For purposes of economy in research, we might want to rule out the effects of other conditions which we felt would also have an effect on length of service. We might believe that salary levels would be related to length of service but, if we were primarily interested in the effects of communication, we would either randomize salary levels among our subjects or we would examine length of service within groups of teachers having salary levels relatively the same. The point is that we would pay attention in one way or another both to communication levels and salary levels (as well as other variables we think might be relevant) and the conclusions we would draw from our study would necessarily be circumscribed by these relevant variables. If we hold a variable constant at one level, then our conclusions must speak of our findings within this particular slice of total domain. If we select subjects

randomly from among a certain set of conditions, then our conclusions are complete only if they state that we have ignored the effects of this variable (which we think might have had effects had they been allowed to show). To repeat, we begin a study by trying to become aware of the variables which are important in circumscribing the domain which we want to study.

It is not easy to become aware of the variables which put the "boundaries" on the domain we want to study. One of the difficulties is the ever-present bias on the part of the experimenter toward his own particular ways of looking at the world. Selecting variables (a) to be examined, (b) to be randomized, and (c) to be ignored typically becomes a matter of intuition instead of a systematic sequence of deliberate decisions. Another difficulty arises from the very technique of randomization in assigning subjects to experimental conditions. Randomizing rules out from observation the effects not only of variables which we are aware might be relevant but also the effects of those of which we are unaware. What we need is some method which will enable us to be systematic in thinking about the domain which we are setting out to study.

The beginning logic of facet design is extremely simple; it is simply that of the Cartesian coordinates you used when you drew graphs in algebra class in junior high school. The chief differences are (a) that we do not always deal in the social sciences with numerical quantities along the coordinates and (b) we typically deal with many more coordinates than we were able to put on the graph in junior high school.

To be more exact, we might list at the left-hand side of a page some conditions of one sort and across the bottom of the page some conditions of another sort. By drawing horizontal and vertical lines, we would then have a grid of cells. Each cell would be designated by a particular condition of the one sort and a particular condition of the other sort. For example, we might list levels of communication up the left side of the page and levels of salary across the bottom of the page; in a particular cell we would then enter observations of length of service on the part of those teachers who were characterized by that particular salary level and that particular amount of communication in their school. Comparisons of length of service in relation to level of



communication with salary held constant could then be made up and down a column of the diagram, while comparisons of length of service in relation to salary levels with level of communication held constant could be made left and right along the rows of the diagram. Comparisons taking into account both communication and salary would be made diagonally. In this example, communication is one facet and the various levels of communication are the elements of that facet. Salary is the other facet. The variable of length of service is, of course, the dependent variable and the values of this variable constitute what Guttman calls the "range."

Taking this example a little farther, let us suppose for the sake of illustration that we predict that length of service will be longer where levels of communication are higher and also where salaries are higher. We would then expect that the average length of service would increase in the cells reading from left to right along a row and would also increase in the cells running from bottom to top in a column. Furthermore, we would predict that the average length of service in any particular cell would be higher than in cells to the "southwest" of it. On the other hand, we would not be able to predict the relative magnitudes to be found in cells to the northwest or southeast because the elements corresponding to those cells would be lower in one facet but higher in the other and therefore incomparable. Facet design does not lay out

predictions about all possible comparisons among the sets of conditions specified by the facets.

There is another important feature to be observed in this example. Since the values for length of service increase along a row, a value in one cell is more similar to a value in an adjacent cell than it is to a cell farther away. The same kind of pattern will be true in a column and it will also be true diagonally across the diagram. This pattern reflects what Guttman calls the principle of contiguity, which is the basis for facet analysis. The principle is usually expressed in terms of correlations between observations in different cells rather than in terms of levels of values.

Bastide and van den Berghe

To illustrate the features of facet design and analysis I have been describing, I shall shortly turn to some extended examples. Before doing so, however, let me note here a key distinction between facet analysis and factor analysis, since the two are sometimes confused. In factor analysis, factors are come upon after the data are collected. Quite the contrary is true of facet design. The facets must be chosen before data are collected. This is done, to put it brutally, as best one can. However, there are aids upon which one can rely. One aid, of course, is a theory about the domain being studied -- if one is available or can be built. Another way to go about it, which is exemplified in the article excerpted below, is to study the materials available concerning the domain, looking for concepts which, when put together in the criss-crossing manner of the Cartesian space, will specify all the sets of conditions which one has found in his inspection of the domain. This latter method was used in the first example below. The example consists of excerpts from an article by Guttman published in 1959 in the American Sociological Review. This article takes data previously published by other authors, recasts them into a facet design, and subjects them to a facet analysis. The original article (written by the other authors) reported a study conducted within a domain of interest conceived in the usual intuitive

manner. Guttman's study of their study shows clearly how the domain can be specified much more precisely, how a family of hypotheses flows directly from the facet design, and how the validity of the facets originally chosen can be checked in one coherent facet analysis. You should pay particular attention as you read along to the manner in which the facet design illuminates the domain of interest well beyond that portion of the domain which was investigated by the original authors.

In a recent article, Bastide and van den Berghe describe four types, or subuniverses, of content in connection with interracial behavior: stereotypes, norms, hypothetical interaction, and personal interaction. They present some interesting empirical findings in these areas, based on their Brazilian research, including a set of correlations among the four subuniverses. The purpose of the present paper is to suggest a structural theory for the observed interrelations among the four subuniverses.

The four varieties of interracial behavior on which we are focussing are described briefly by Bastide and van den Berghe. For our present purposes, it is convenient to restate and to capsulize the descriptions. The following are definitions of the subuniverses of the four types:

I. Stereotype: Belief of (a white subject) that his own group (excels -- does not excel) in comparison with Negroes on (desirable traits).
II. Norm: Belief of (a white subject) that his own group (ought -- ought not) interact with Negroes in (social ways).
III. Hypothetical Interaction: Belief of (a white subject) that he himself (will -- will not) interact with Negroes in (social ways).
IV. Personal Interaction: Overt action of (a white subject) himself (to -- not to) interact with Negroes in (social ways).

Underlinings and parentheses used in the above definitions are intended to indicate the semantic structure we are positing for intergroup behavior, and each will be explained.

All four definitions have in common the fact that they involve a white subject and Negroes. The phrase "with Negroes" occurs uniformly in each of the definitions, as does "a white subject." The intergroup behaviors of some pairs of groups other than whites and Negroes can be defined merely be replacing "white" and "Negroes" with the respective characterizations of the desired groups. It is convenient to think of specific groups, such as Negroes and whites, in developing our theory. The theory may be enlarged subsequently by letting the groups vary according to some principle.

The common or fixed elements indicate the universe of which the subuniverses are subsets. Since the subuniverses nevertheless differ among themselves, our first task is to ascertain the facets which determine those differences.

The four definitions differ among themselves primarily on three facets, the elements of which are underlined in the definitions given above. Each definition concerns a type of behavior of a subject vis-a-

vis a type of intergroup behavior of a type of referent. Two kinds of behavior for the subject occur in the definitions: belief (a form of covert behavior) and overt action. Also, two kinds of referents occur: the subject's group and the subject himself. Similarly, two kinds of intergroup behavior are distinguished: comparative and interactive.

Thus, each of the three facets occurs as a dichotomy. It is helpful to list them and their elements in tabular form, assigning symbols to each for later use as in Table 1.

TABLE 1. Facets on Which Subuniverses Differ

A = Subject's Behavior	B = Referent	C = Referent's Intergroup Behavior
a_1 = belief	b_1 = subject's group	c_1 = comparative
a_2 = overt action	b_2 = subject himself	c_2 = interactive

The capital letters A, B, and C denote the three facets, while the corresponding small letters with subscripts denote the elements of the respective facets.

Three dichotomous facets yield eight (= 2 x 2 x 2) possible combinations of three elements each, one element from each facet. That is, the Cartesian product of the three facets, which may be denoted by ABC, is a set of eight profiles, each profile having three components. Each profile defines a different subuniverse. But we have defined above only four subuniverses, or only a subset of ABC. We may tabulate this subset explicitly as follows:

	Subuniverse	Profile
I.	Stereotype	$a_1b_1c_1$
II.	Norm	$a_1b_1c_2$
III.	Hypothetical Interaction	$a_1b_2c_2$
IV.	Personal Interaction	$a_2b_2c_2$

A striking feature revealed by this tabulation is that the profiles form a perfect scale. For each facet, a single cutting point in the rank order of the subuniverses suffices to divide the elements with subscript "1" from the elements with subscript "2." For facet A, the cutting point is between III and IV; for facet B, between II and III; and for facet C, between I and II. If we arbitrarily call subuniverse I the left end of the scale, we have the rank order I < II < III < IV, or more verbally: Stereotype < Norm < Hypothetical Interaction < Personal Interaction. The symbol "<" is used merely to signify that what is to the left of the symbol precedes what is to the right of the symbol in the rank order.

Scale structures have been found in various kinds of empirical data -- in ranking people, social institutions, political units, and so on. We now find the same structure in ranking abstract concepts. In the empirical cases, only approximately perfect or quasi-scales are the rule, which sometimes raises troublesome problems of how to handle scale error. On the nonempirical, conceptual level, truly perfect scales are not at all impossible, as exemplified above, with no problem of scale error.

Semantic meaning for the rank order requires exploration. According to scale theory, ordering the profiles also implies a formal ordering of the categories <u>within</u> each facet. The ordering I < II < III < IV implies formally the three simultaneous orderings: $a_1 < a_2$, $b_1 < b_2$, $c_1 < c_2$. Do these further orderings have any common <u>semantic</u> meaning, formalisms aside? If not, the formal scale of the four subuniverses need have no clear semantic meaning.

A common meaning for the orderings can be suggested: they show in each case a progression from a <u>weak</u> to a <u>strong</u> form of behavior of the subject vis-a-vis Negroes. "Belief" is weaker than "overt action" in being passive rather than active. Referring to the behavior of "subject's group" is weaker than the subject referring to "himself," insofar as the subject's relations with Negroes are concerned. "Comparative" behavior is weaker than "interactive" behavior since it does not imply social contact; a comparison is more passive than interaction.

Accepting this interpretation of the orderings within facets, we can say that the ordering of the subuniverses themselves also runs from weakest to strongest. "Stereotype" is the weakest form of intergroup subuniverse, "Personal Interaction" is the strongest form, while the other two subuniverses are intermediate in strength, in the indicated order.

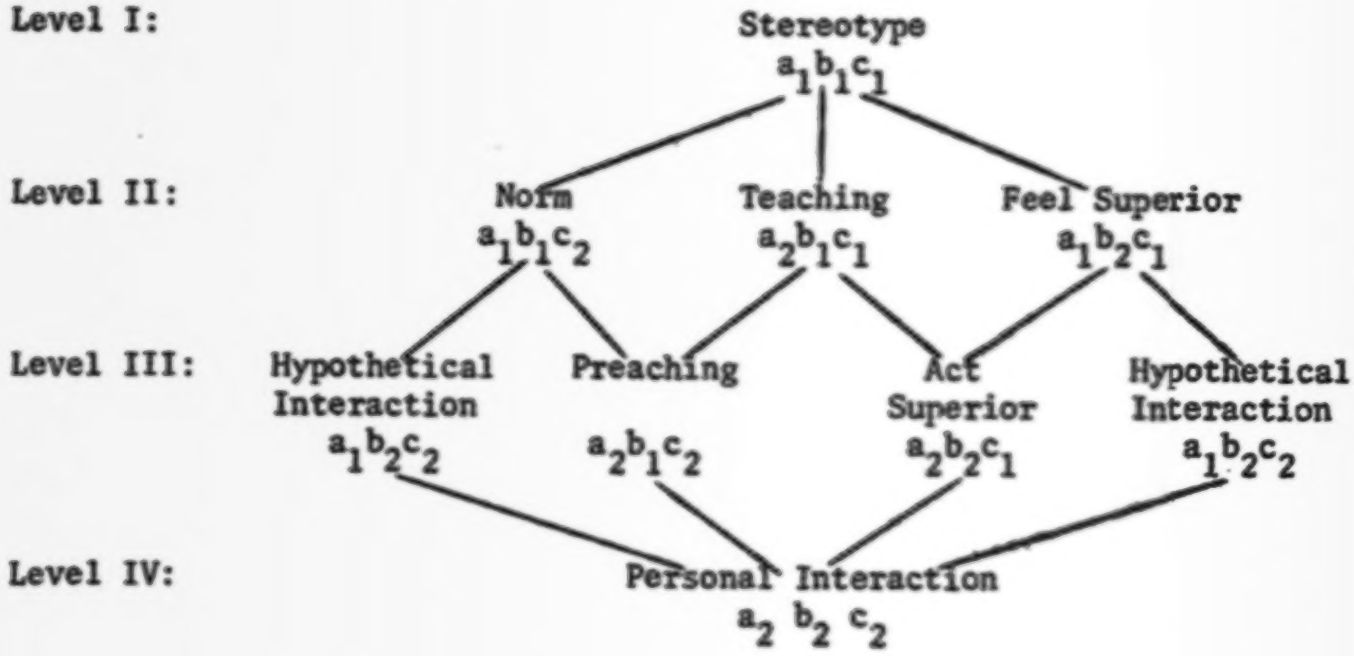
What of the profiles from ABC that were not indicated among the original four definitions? These can define further subuniverses. Thus:

Two of the omitted profiles are $a_2b_1c_1$ and $a_2b_1c_2$. Each of these, according to its first two components (a_2b_1), concerns overt action (a_2) of the subject with reference to the subject's group (b_1). Presumably, each implies that the subject should activate or stimulate his group -- in one case as to how it compares itself with Negroes (c_1), and in the other, regarding interaction with Negroes (c_2). The first case might be called "Teaching" and the second "Preaching."

The remaining two omitted profiles are $a_1b_2c_1$ and $a_2b_2c_1$. According to their last two components (b_2c_1), each of these concerns the comparison (c_1) of the subject himself (b_2) with Negroes as to desirable traits. The first profile might be called "Feel Superior" and the second "Act Superior."

Six scales are possible, given the orderings $a_1 < a_2$, $b_1 < b_2$, $c_1 < c_2$ for the three facets. One way of bringing this out is to portray the entire universe as a partly ordered set, as in Figure 1.

Figure 1



The connecting lines between "levels" in the figure show the pairs of profiles between which the inequality relation "<" holds. If abc and a'b'c' are any two different profiles, then abc < a'b'c' if and only if simultaneously $a \leq a'$, $b \leq b'$, $c \leq c'$.

In a scalable series of levels, each profile differs from its predecessor on only one facet. Starting with Stereotype as Level I, this allows for only three possible profiles for Level II, for there are only three subscripts in Stereotype that can be raised from a "1"

to a "2." Since each profile in Level II has only two subscripts of "1" that can be changed to a "2," there are only two ways that a profile can move to Level III, so each has two lines branching down from it. For convenience, we have listed Hypothetical Interaction twice on Level III in the figure in order to avoid criss-crossing lines. There are only three profiles possible at Level III, since there are only three ways of having one subscript equal to "1" and the remaining two equal to "2." The scales are the six continually descending possible pathways from Stereotype to Personal Interaction in the diagram, along the lines running from level to level.

The universe is only partly ordered, for many pairs of profiles are not comparable. For example, we cannot say that the inequality "<" holds between Norm and Act Superior, in either direction; while the latter exceeds the former on facets A and B, the reverse is true on facet C. Any two profiles of the same level are noncomparable for similar reasons.

Bastide and van den Berghe apparently carried out no tests of scalability for their data. It seems plausible, however, that each of their subuniverses should be at least quasi-scalable. For purpose of our present discussion, let us accept the hypothesis that numerical scores may be sufficient for studying the empirical interrlationships among the subuniverses. Let us accept the empirical correlation coefficients of the Brazilian study as a correct picture of the relationships among the subuniverses considered.

The empirical product-moment correlations between the eight subuniverses of ABC for population P may be calculated. Our analysis above of the semantic structure of ABC provides a social-theoretical basis for predicting the structure of this empirical correlation matrix. One cannot presume to predict the exact size of each correlation coefficient from knowledge only of the semantics of universe ABC, but we do propose to predict a pattern or structure for the relative sizes of the statistical coefficients from purely semantic considerations.

Since the Brazilian data allow us to check our prediction only with respect to the intercorrelations of scores on four of the subuniverses (those earlier labeled I, II, III, and IV), we concentrate first on these. Our prediction is based on the following proposition:

Contiguity Hypothesis. Subuniverses closer to each other in the semantic scale of their definitions will also be closer statistically.

Statistical closeness is measured approximately (but not always exactly, as we shall indicate below) by correlation coefficients. According to the contiguity hypothesis, generally Stereotype should correlate more highly with Norm than with Hypothetical Interaction,

and almost certainly more than with Personal Interaction: $r_{I\ II} > r_{I\ III} > r_{I\ IV}$. Similarly, we should have approximately $r_{II\ III} > r_{II\ IV}$, $r_{III\ II} > r_{III\ I}$, and $r_{IV\ III} > r_{IV\ II} > r_{IV\ I}$. These exhaust the predictions that are directly possible, or where differing degrees of contiguity are defined by semantic rank order considerations for the subuniverses.

The actual correlation matrix reported by the authors of the Brazilian study is equivalent to the presentation in Table 2. The structure of this correlation table is virtually as predicted. The largest correlations tend to be adjacent to the main diagonal, corresponding to the semantically contiguous subuniverses -- and they taper off to the northeast and southwest corners of the table, where semantic differences increase.

TABLE 2. Empirical Intercorrelations of Scores on the Four Subuniverses

Subuniverse	I Stereotype	II Norm	III Hypothetical Interaction	IV Personal Interaction
I. Stereotype	-	.60	.37	.25
II. Norm	.60	-	.68	.51
III. Hypothetical Interaction	.37	.68	-	.49
IV. Personal Interaction	.25	.51	.49	-

An apparent slight exception to this structure is that $r_{IV\ III}$ (= .49) does not quite exceed $r_{IV\ II}$ (= .51), despite the fact that semantically III lies between II and IV. This need be no actual contradiction of the contiguity hypothesis, as should become evident in the explicit discussion of statistical distances below. Sampling error, of course, might also be offered as a tentative explanation for the apparent aberration, but we prefer to ignore such "outs" for the purpose of the exposition of our theory. The selection of the 580 subjects used from the Brazilian population is described as "neither random nor proportional"; even this need not affect our structural theory. The relative patterning of correlations needs not change even though the absolute sizes of the coefficients might. Idiosyncracies of sampling and biased selections of subjects often can violently affect arithmetic means and other averages, as well as variances and other measures of dispersion. Correlation coefficients are often harder to destroy or to build up artificially, and the possible attenuation or disattenuation is even less likely to alter the pattern of correlations, since

such effects usually influence correlation coefficients by constants of proportionality.

Had we empirical data for the complete matrix of correlations among all eight subuniverses, the validity of our structural theory as thus far developed could be checked further. The empirical results could be compared with the calculated results, and thus verify the adequacy of the structural theory.

Failure of the results to check out could imply either or both of the following possibilities: the statistical structure deduced from the semantic structure was not appropriate; the semantic structure was faulty or incomplete.

Note that the facet design, in contrast to the original limited design, lays out all the sets of conditions (or "subuniverses") which are relevant to the kind of hypothesis chosen by the original authors. The facet design immediately produces an entire family of hypotheses; namely, those comparing "favorableness" in any two or more of the eight cells or subuniverses. The use of the principle of contiguity in the analysis makes an immediate check on whether the ordering of the elements in the several facets were properly chosen, and whether the facets and their elements were valid in the sense of supporting the prediction which the principle of contiguity makes. The principle of contiguity, in turn, is merely a direct inference from the meaning of "ordering" the elements within the facets.

The facet design in the study quoted above clearly exemplifies another advantage of this tool. In the restatement by Guttman of the descriptions of the subuniverses (labeled in Roman numerals in the second paragraph of the excerpts) it is easy to see some kinds of facets which could be added so as to enlarge the domain of study. In fact, each phrase enclosed in parentheses in the descriptions of the subuniverses suggests another kind of facet which might be explored. The particular elements which might be chosen to compose these facets are, of course, up to the ingenuity and theoretical acumen of the investigator.

Salary Levels in the Civil Service

Let us now turn to another application of facet design. Some time ago Guttman's institute was given the task by the Israeli government of developing guides or rating sheets which could be used to establish the salary levels of jobs within the Israel Civil Service. After a great deal of interviewing and studying job specifications to determine what people felt was meritorious about the duties and skills demanded by the various jobs, Guttman and his colleagues decided upon the five facets labeled with capital letters on the next page. The next task was to develop a set of items based on these facets which could be used to evaluate the various jobs in the system. Once the facets and their elements were chosen, the construction of items for evaluating job level was straightforward.

The facets described in the tabulation specify 3 x 4 x 3 x 3 x 3 or 324 cells; that is, 324 types of jobs. Since the elements within each facet are ordered according to level of restriction on work, cells specified by elements with larger subscripts are at higher levels than cells specified by elements with smaller subscripts. Accordingly, an instrument or rating sheet can be devised on which each item carries the specifications of some cell out of the 324. However, not all of the 324 possibilities would be useful; as we have seen earlier, not every cell in the complete design can be said to be higher or lower than every other. Furthermore, one encounters practical difficulties which reduce the number of items which might be used, such as difficulties in phrasing items, amount of time or fat gue required to answer the items, and so forth.

The nature of the items finally selected is shown in the lower half of the tabulation. Each combination of small letters characterizes an item. For example, a_1b_1 would sound something like, "A person in this job passes on information or materials without change according to detailed instructions provided him." The item a_3b_4 might read simply, "Creates policy." The item $b_3c_3d_3$ might read, "Periodically, the person in this job seeks advice from others of his own choosing on whether his

FACETS FOR JOB EVALUATION

(by L. Guttman for Israel Civil Service)

Types of restriction on work (facets):

A	B	C	D	E
Freedom to change things	Guideline	Subordination to supervisor	Supervision	Level of other person's job
a_1 transmit as is	b_1 detailed instructions	c_1 receives instructions	d_1 continuous, direct	e_1 mixed
a_2 modify	b_2 general instructions	c_2 consults	d_2 on completion of task	e_2 high
a_3 compose or create	b_3 policy	c_3 independent (selects advisors)	d_3 periodical review	e_3 very high
	b_4 creates policy			

Design of the items for job evaluation:

Originality and initiative	Judgment	Level of contact	Level of expression	Supervision over the job
a_1b_1	$a_1b_1c_1$	$a_1c_1e_1$	a_1b_1	$b_1c_1d_1$
a_2b_1		$a_2c_1e_1$		
				$b_1c_1d_2$
	$a_2b_2c_1$		a_2b_2	$b_2c_1d_2$
	$a_2b_2c_2$	$a_2c_2e_1$		$b_2c_2d_2$
		$a_2c_2e_2$		
		$a_2c_3e_2$		
a_3b_2				
		$a_3c_3e_3$		
a_3b_3	$a_3b_3c_3$		a_3b_3	
				$b_3c_3d_3$
a_3b_4	$a_3b_4c_3$			

actions are carrying out the policy directives under which he works." Each line across the page in the lower half of the tabulation contains items which are at the same "level"; items lower on the page represent jobs of higher level than items higher on the page. All told, the lower half of the tabulation contains 24 items distributed over twelve levels.

Again, the principle of contiguity can be used to check the validity of this design. The principle of contiguity states that jobs described by adjacent cells of the facet design should be close together in their salary ranges. If it turns out in practice to be difficult to maintain this relation among salary ranges, then the evaluation scheme will have been shown to be invalid.

The example just given shows how a facet design can be used to generate measuring instruments and also shows the fact that the facets the investigator uses for thinking his way through the problem do not restrict the manner in which the investigator need talk to the people he is studying. The types of items in the lower half of the tabulation are headed with titles which are in terms more familiar to personnel workers than are the titles of the facets.

Communication in Schools

Let us now turn to another example. In a study concerning communication in high school faculties which I am at present pursuing, one of the hypotheses is as follows:

> Hypothesis 1. Given pairs of persons in disagreement at Time 1, such pairs which remain in disagreement will be found at Time 2 not to have increased their communication, while pairs which increased their agreement will be found not to have decreased their communication.

This hypothesis is embedded in a domain which (because of some other hypotheses) also includes factors of the social support an individual receives for his opinion from other persons. The facets for this domain are shown on the next page. Instead of merely listing the facets with their elements, a form different from the earlier examples is used

BEHAVIORAL DOMAIN FOR HYPOTHESIS 1

Given that respondent$_1$ is an individual in strong disagreement with respondent$_2$ at Time 1 in respect to the appropriate duties of the counselor, then:

A	B	C
respondent$_1$ (who is a	teacher	receiving strong social support from
respondent$_2$	counselor	moderate
	administrator	weak

D

another, where the other is receiving strong social support and is a
moderate
weak

E	F
teacher)	reports his communication with the other at Time 1 in terms
counselor)	the other at Time 2
administrator)	

R G

of its frequency and in respect to general communication.
teaching-topics communication.
guidance communication.

in this diagram. The elements of the facets (labeled with capital letters) are embedded in a sentence which describes the kind of domain which is being investigated. The capital letters A through G designate the facets; the letter R does not properly stand for a facet but rather for the "range" or dependent variable. It will be seen in the beginning of the sentence composing the diagram that certain possible facets are being held constant; that is, this is really a subdomain of a conceivable larger domain.

A great variety of sentences can be made from the sentence in the diagram simply by picking, under each capital letter, just one of the elements listed. An entire family of hypotheses is thereby generated simply by performing the comparison called for by any two different sentences in respect to frequency of communication. It is clear that the diagram shows a great many questions which would remain unanswered if the investigator were to limit his attention to the hypothesis as originally stated.

Selecting Trainees in Counseling

Now let us turn to a final example. Another job which was put into the hands of the Israel Institute of Applied Social Research was to develop an interviewing procedure which would select teachers who were applying for training to become vocational guidance counselors. The following pages describe the procedure finally worked out. I am reproducing the instructions for the interview, four forms for the interview, and two rating forms. You will not, however, find a list of the facets used. I leave inferring a list of facets from these materials as an exercise for the reader.

In the examples given here, I have discussed some methods of analysis which are primitive compared to what might be done with an electronic computer. Fortunately, methods of analysis based on the logic of facet design have recently been developed for use with a computer. These developments are due to James Lingoes, of the University of Michigan, working in close collaboration with Guttman. You will find references to this important work in the bibliography.

NOTE: The facet designs for (a) job classification and (b) interviewing applicants for training in counseling are taken from informal materials distributed by Guttman in a seminar held some years ago at the University of Illinois; they should not be cited or quoted as representing current practice in Israel.

The Government of Israel
The National Institute for Vocational Guidance

Interview of Counseling Teachers
Instructions for the Interview

a) Systematic interchange of tasks among the members of the acceptance committee.

1) Every member of the committee will serve in one of the following tasks in each interview: (a) interviewer, (b) rater with form "A," and (c) rater with form "B."
2) The tasks of each interviewer will be interchanged at the end of each interview. The committee member who was an interviewer at a certain interview will serve as a rater at the following interviews, until his turn comes again to serve as an interviewer.
3) A member who was a rater with form "A" at a certain interview will rate the next interview with form "B" and vice versa (until his turn comes again to be an interviewer).

b) The 4 forms of the interview.

1) Attached herewith are 4 parallel forms of an interview each of which includes 9 questions. The first interviewer employs form No. 1, the second employs form No. 2, etc. The fifth returns to form No. 1 and so on.
2) Before the beginning of each interview, the rater must mark on his rating form, at the proper place, which form of interview was used.
3) Before the beginning of the interview, each interviewer has to take care that the rater marks properly on his form the type of interview that is being used.

c) Filling out the rating forms.

1) At each interview, half of the raters will fill out rating form "A," and the other half will fill out form "B." If the number of raters is not even, it is necessary to arrange that the form will be filled out evenly in the course of the whole set of interviews.
2) Before each interview it is necessary to take care of the interchange of tasks among interviewers and raters and also among raters in accordance with the instructions of paragraph "a" above.

Interview of Counseling Teachers
Form 1

1) What are the things in your present work that you are satisfied with, and why?

2) What do you see as the main function of the teacher?

3) Describe the relations that have developed between you and the children with whom you worked last year.

4) Tell me about your work with children in general.

5) In which things was your work with pupils successful and in which were you less successful?

6) To what extent do you have, according to your opinion, the necessary requirements for a good teacher?

7) Describe your past achievements in teaching.

8) To what extent did your class achieve the curriculum requirements?

9) Tell about a child whose specific personal problem you have treated.

Interview of Counseling Teachers
Form 2

1) Tell about the problems you have encountered in your work.

2) What are the problems that you may encounter in couseling work, according to your opinion?

3) Did you have an occasion to know children who needed coumseling especially? Describe your relations with them.

4) Tell about your work with children in general.

5) Did you have an occasion to know children who need counseling? Can you describe their problems?

6) To what extent, do you think, you have the necessary traits of a good counselor?

7) Describe the teaching achievements you had in the past.

8) On what did it depend that your class did not achieve in the curriculum more than it did?

9) Concerning personality, what differences did you find between the children that you taught and rural children, urban children, and children from other institutions?

Interview of Counseling Teachers
Form 3

1) What are the things in your present work that you are not satisfied with, and why?

2) What are, in your opinion, the characteristics of a good teacher?

3) Describe by what method you succeed in gaining the confidence of the children with whom you work.

4) Tell about your work with children in general.

5) In which things did you succeed in your work with pupils, and in which things have you been less successful?

6) What is it that gives you satisfaction in your work as a teacher?

7) Describe your past achievements as a teacher.

8) To what extent did your class achieve the curriculum material?

9) Tell about a child whose specific personal problem you have treated.

Interview of Counseling Teachers
Form 4

1) Tell about your work.

2) What are, in your opinion, the characteristics of a good counselor?

3) Describe the relations that have developed between you and the children with whom you worked last year.

4) Tell me about your work with children in general.

5) Did you ever have an occasion to get acquainted with children who needed counseling? Can you describe their problems?

6) What do you find especially interesting in your work as a teacher?

7) Describe your previous achievements in teaching.

8) Upon what did it depend that your class did not achieve some of the curriculum material?

9) Concerning personality, what differences did you find between the children that you taught and rural children, urban children, and children from other institutions?

Rating Form of the Interview
Type A

Interviewee _____ Name of Rater _____

Place _____ Date _____

Form of Interview 1 2 3 4

		No. of question								
		1	2	3	4	5	6	7	8	9
a.	Facts only	1								
	Mainly facts	2								
	Many opinions	3								
	Opinions only	4								
b.	Achievements only	1								
	Mainly achievements	2								
	Achievements and problems	3								
	Mainly problems	4								
	Problems only	5								
	Neither of these	6								
c.	Almost all about himself	1								
	A lot about himself	2								
	Little about himself	3								
	Almost nothing about himself	4								
d.	Almost only about the children with whom he worked	1								
	Much about the children with whom he worked	2								
	Little about the children with whom he worked	3								
	Not at all about the children with whom he worked	4								
e.	His description of the children									
	absolutely positive	1								
	mainly positive	2								
	neutral	3								
	mainly negative	4								
	absolutely negative	5								

Additional remarks:

Rating Form of the Interview
Type B

Interviewee _____ Name of Rater _____

Place _____ Date _____

Form of Interview 1 2 3 4

	No. of question								
	1	2	3	4	5	6	7	8	9
1. Answer -- expansive with respect to question	1								
To the question but also going beyond	2								
Restricted with respect to question	3								
Evades the question	4								
2. Much hesitation	1								
Careful	2								
Unhesitating	3								
Exaggerated confidence	4								
3. Expresses himself with difficulty	1								
Expresses himself with some difficulty	2								
Fluent (without any difficulty)	3								
Exaggerated fluency	4								
4. Expresses himself very unclearly	1								
Quite unclearly	2								
Clearly	3								
Very clearly	4								
5. Special symptoms of nervousness (like biting the nails, etc.)	1								
Usual symptoms of nervousness but to a conspicuous extent	2								
Usual symptoms of nervousness to a limited extent	3								
Without any symptoms of nervousness	4								
Expressionless	5								

Description of the symptoms of nervousness:

_____

Additional remarks:

THEORY OF DATA

We can conveniently think of research as having five phases. The first phase is that of selecting a universe of potential observations -- or, in our earlier terms, a domain of investigation. The criterion for choosing a domain for investigation (which, of course, is different from choosing facets to specify the domain) is simply that of personal preference.

The second phase is that of recording observations made within the selected domain. In this phase one must choose what observations to make. It is at this stage that facet design is especially helpful. One does not wish to find that he has omitted to make observations on a vital part of the domain, nor does he wish to find that he has wasted his time being redundant.

The third phase is to convert one's observations into data. If this sounds like an odd statement, let me give a brief example. Suppose that we have recorded the fact that John was not admitted to Rutgers. I can think of at least four conclusions which could be drawn from this observation: (1) John is not smart enough to get into Rutgers, (2) John is too far off to the side of genius for Rutgers' screening test to recognize, (3) Rutgers' standards are too high for John, (4) Rutgers is too stupid to recognize a good man when they see one. Two of these interpretations tell us opposite things about John, and two of them tell us opposite things about Rutgers. Into which datum should we convert our observation? If the information that John was not admitted to Rutgers appeared on a questionnaire containing other items about John, it would no doubt be used to assess the characteristics of John. If it appeared on a questionnaire sent out to people who had been and had not been admitted to Rutgers, it would probably be used to come to some conclusion about Rutgers. In brief, the kind of data we make out of our observations is not a foregone conclusion, but rather a choice which the investigator must make -- a choice, in fact, which he does make, consciously or unconsciously.

The fourth phase is to take the data and classify the individuals or objects to which the data refer in some way which will simplify thinking about the data. This process is often called scaling. One technique often used is simply to add up the number of data which are interpreted as pointing in a certain direction. Very often this phase is followed by a fifth phase which consists of seeking relations which might exist between one classification of data or another classification; in other words, seeking relations among variables.

The theory of data deals with the stages of making data out of observations and of making variables out of data. Although over the years a great amount of thought has gone into various aspects of these phases of research, it is only recently that a scheme has been proposed (by Coombs) which promises to encompass all the facets encountered in these problems. If this seems too strong a statement, let me say at least that Coombs has proposed some facets which seem to be encountered whenever we convert observations into data and whenever we convert data into variables, and that these facets enable us to compare one with another the great variety of methods now in existence. Furthermore, Coombs' theory of data systematizes the field in such a way that we can use it to tell ourselves how to invent new methods of collecting data and how to choose appropriate methods for analyzing data gathered by old or new methods. I want to carry my explanation in this paper far enough so that you can see how the theory can enable you to invent some new methods of data collection.

Some people feel that the method of data collection is of little importance. Let me give a small example of a way in which one can come to quite different conclusions from identically the same actual situation because of different methods of data collection. Let us suppose that there are three candidates among whom one is to be elected. Suppose that ten voters prefer the candidates in the order ABC as shown in the tabulation below, ten others prefer them in the order BCA and a third ten prefer them in the order CAB. The chairman takes a vote and finds that the candidates have fallen into a three-way tie. Thereupon the chairman adopts a run-off method and asks the voters first to choose between

Voter type	Preference order
1	A to B to C
2	B to C to A
3	C to A to B

candidates A and B. As we see from the tabulation, the first and the third groups of ten voters prefer A to B, while only the second group of ten voters prefers B to A. B is therefore eliminated, and you can see that C would get twenty votes to A's ten in the run-off between A and C. Thus, C wins.

But suppose that the chairman had first decided to pit B against C. The first and second groups of ten would have voted for B over C while only the third group would have voted for C over B. Thus, C would have been eliminated. In the run-off between A and B, A would have won! Similarly, B would win the election if the chairman were to begin with a contest between A and C. In brief, the winner of the election in this case depends entirely upon how the chairman decides to collect the data concerning the voter preferences. (It should be noted also that this example does not depend upon having equal groups of voters. The same conclusions can be reached if any two groups of voters outnumber those in the third group.)

The theory of data begins with the interpretation that any datum can be represented by a relation on a pair of points (or on a pair of pairs of points). For example, if we are interested in the characteristics of John we can call John a point representing an "individual" and Rutgers a point representing an object or a "stimulus." We can then represent the observation that John was not admitted to Rutgers by saying the relation between the two points is that the "individual" point is on the "negative" side of the "stimulus" point. If we are interested in evaluating Rutgers, we would call Rutgers the individual point and John the stimulus point.

The theory of data is built principally on only three facets, each one of which contains only two elements. The first facet asks

whether the datum is to be represented as a relation on just one pair of points or whether it is to be represented by a relation on two pairs of points; that is, by a relation on two distances. The second facet asks whether the datum is to be represented by points from one set or from two sets; that is, points from a set representing (a) only individuals or only stimuli, or (b) points from both sets. The third facet asks whether the relation is an order relation or a proximity relation. Coombs lays out these facets in a form similar to that shown in the diagram headed "The Data Quadrants." The elements of the first two facets specify the "quadrants" and the elements of the third facet correspond to the "a" and "b" within each quadrant. Some examples of data are given within each of the quadrants of the diagram.

It turns out that most methodologists have preferred to collect data by methods customarily interpreted as belonging in Quadrant II. Methods typically used to collect data for this quadrant are the mental test methods, attitude questionnaires, "pick one," rating scale methods, magnitude estimation, and others. Quadrant III has received increasing attention in recent years, while Quadrant IV has had so far the least attention of the four. In this paper I shall limit myself to telling you about Quadrant I.

Quadrant I provides the model for data which are interpreted as meaning that an individual prefers object A to object B. Of course, we need not limit ourselves to asking an individual about only two objects at a time. For example, we can ask John, "What is your rank-order preference among Rutgers, Harvard, Princeton, and Yale?" Sometimes in a conversation we ask a person about his preferences among three or four objects and then, if we feel we do not have enough information, we ask him about a different assortment of three or four objects. We might go on to ask John, "Well, how do you fell about Rutgers, Princeton, Michigan, and Oregon?" In other words, we can present the individual with different assortments of objects among which we want him to tell us his preferences.

THE DATA QUADRANTS

Two sets: both individuals and stimuli

One pair of points	Two pairs of points (distances)
Quadrant II: Single Stimulus QIIa (ordinal): John exceeds Rutgers. For example, John passes Rugers' requirements. QIIb (proximity): John is closer to Rugers (from either direction) than some criterion distance. For example, John's ability is close to the average at Rutgers.	**Quadrant I: Preference** QIa (ordinal): The distance from John to Rutgers is less than that from John to Harvard. For example, John's preference for Rutgers is greater than his preference for Harvard. QIb (proximity): not collected.

One set: individuals or stimuli

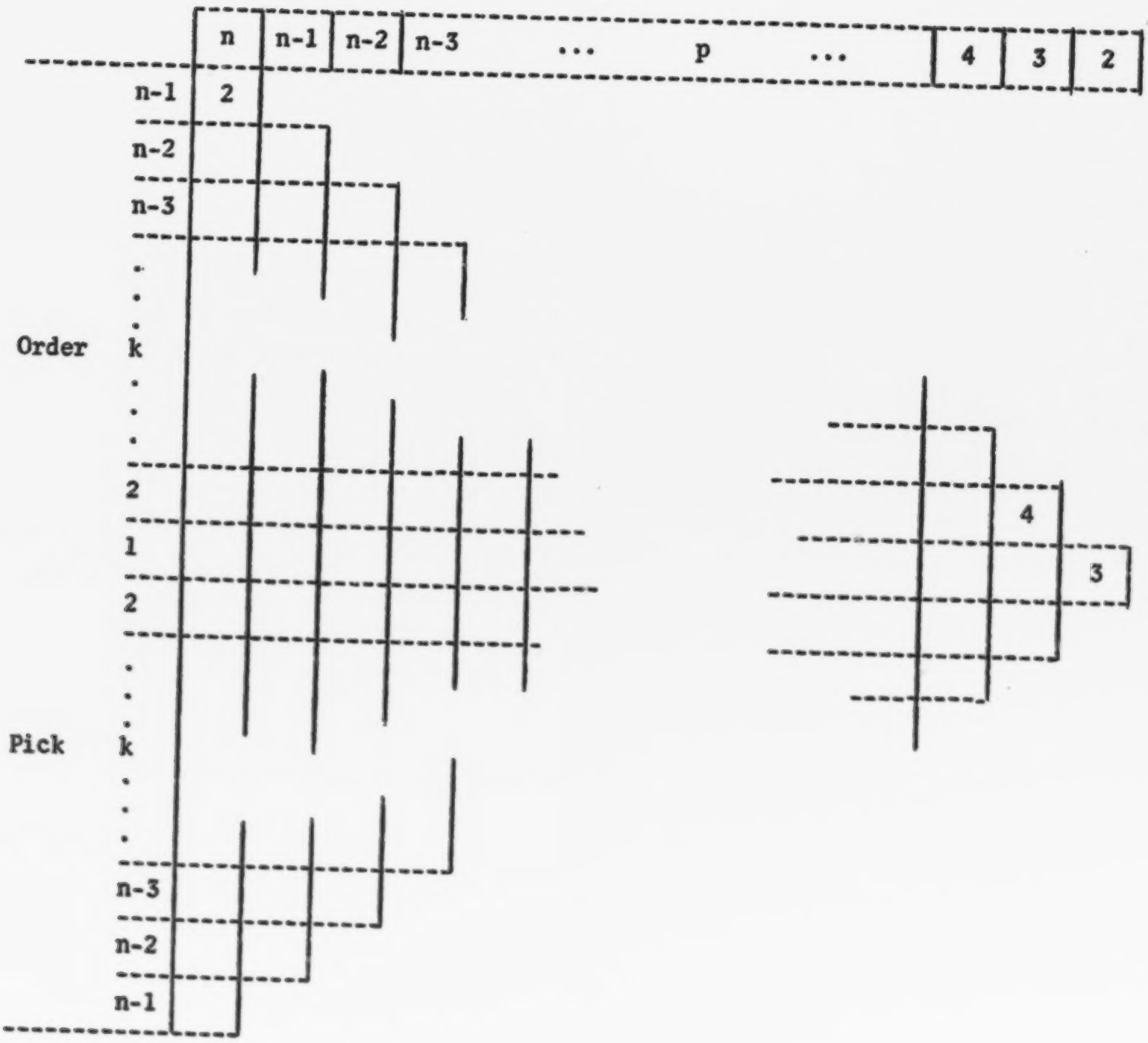
One pair of points	Two pairs of points (distance)
Quadrant III: Stimulus comparison QIIIa (ordinal): Tuition at Rutgers is higher than at Harvard. QIIIb (proximity): Tuition at Rutgers is about the same as at Harvard.	**Quadrant IV: Similarities** QIVa (ordinal): The difference between tuition at Rutgers and Harvard is less than the difference between Rutgers and Princeton. QIVb (proximity): no models for analysis yet available.

We need not ask the individual for a rank-order. Sometimes we might ask a young man, "To which colleges out of this list did you apply?" If he has picked three out of the list we can interpret this behavior as telling us that those three colleges were closer to his ideal than the remainder on his list. These examples suggest quite a few different ways of collecting data. First, we can be concerned with n total objects. Second, we can present p of these n objects to the individual at a time. Third, we can ask him to pick k out of the p presented to him as most preferred, or we can ask him to order k out of the p presented to him. These facets within Quadrant I enable us to lay out an entire grid of methods of collecting data. This grid is called by Coombs the "search-ingness structure" and is displayed on the next page. This chart as shown here has no certain number of rows or colums because n is unspecified. The quantity n is, as I said before, the total number of objects or stimuli about which one wishes to get information from his subjects. The number of stimuli which can be presented at a time are arrayed across the top of the chart and the numbers of those stimuli which the investigator asks the subject pick or order are arrayed down the left side of the page. Every cell in the diagram represents a particular way one might go about getting preference information from subjects.

Of all these possible methods, only four are well known. The cell near the middle left side of the diagram labeled "1" is one version of the method of single stimuli; one presents all the stimuli in which one is interested and asks the subject to "pick one." At the top of that column, the cell labeled "2" represents the method of rank order; that is, "order n-1 of n." (This is equivalent, of course, to "order n of n.") At the right side of the chart, the cell labeled "3" represents the method of pair comparisons; that is, "pick 1 of 2," which is equivalent to "order 1 of 2." The cell labeled "4" is the method of triads, much less used than the other three; that is, the n stimuli are presented to the subject three at a time and he is asked to order two of the three, which, of course, is equivalent to ordering all three in each presentation.

THE SEARCHINGNESS STRUCTURE

Number of stimuli in a presentation



Beginning with only the two facets which determine the searchingness structure as displayed here, it is clear that a myriad of new ways have been laid out for collecting data. Furthermore, a little thought will show there are other facets which might be added which would generate even more varieties of ways of collecting data, very few of which have as yet been explored in empirical work. In recent years some work has been done with a few of the "new" cells in the chart and it has been amply demonstrated that some of the new methods are indeed considerably more "searching" than the traditional methods.

The searchingness structure, by the way, demonstrates again the power of the facet idea. Psychologists went along for decades working with the methods of single stimuli, rank order, and pair comparisons, and with occasional unsystematic forays into the method of triads; it was not until Coombs looked hard at the ways in which the conditions of data collection could vary that the simple chart of the searchingness structure was laid out and it immediately became evident that a great array of methods of data collection lay as yet unexplored.

The searchingness structure itself is only one example of the kind of idea which is generated by the basic definition of data into eight simple types. Another important idea is the assessment of consistency and transitivity by means of some of the methods laid out in the searchingness structure. Still another is the "unfolding technique," which is crucial in assessing the relations subjects perceive among objects after you obtain from them their preference orders.

But there is not space to go on talking about the theory of data here. Instead, before coming to an end, let me illustrate only one kind of thing which can be done with the concepts generated from Quadrant I of the data types. Reproduced below is a passage from Social Psychology by Newcomb, Turner, and Converse. The study described made use of the method of triads and the unfolding technique. The unfolding technique was elaborated to produce an index of cognitive similarity called "collinearity."

Why does a speaker "get across" better to one listener than to another? There can be a number of reasons, of course, but surely one important factor in transmitting a meaning from one person to another is the extent to which the two persons pay attention to the same aspects of the thing they are talking about. A person who pays attention to certain qualities or aspects of environmental objects in preference to other qualities or aspects has a distinctive "cognitive structure." If we find two people paying attention to the same features or thread in their conversation, we would say they are approaching the conversation with similar cognitive structures and we would predict that the transmission of meaning from the one person to the other would be more complete or quicker than in the case of two persons attempting to converse with dissimilar cognitive structures. This hypothesis was tested by Runkel (1956) in a study examining the transmission of meaning from instructors to college students.

The reasoning behind this experiment was simple. If students are to get good grades, they must learn what kind of statements about the subject matter the teacher prefers; for example, they must be able to pick out pretty accurately the statements on a multiple choice test which the teacher himself would mark "right." The student need not agree with the statements which the instructor favors; he need only be able to select or recognize such statements. Presumably the instructor judges statements according to certain characteristics or "dimensions" and so also does the student. The hypothesis, then, is that meaning will get more quickly or more fully from teacher to student if the two are paying attention to the same characteristics or dimensions of the statements than will be the case when they are paying attention to different dimensions -- and this will be true regardless of whether teacher and student agree on which statements are best.

An analogy may make this more clear. Figure 2 below shows a room full of people. Some are young females (YF); some are old females (OF); some young males (YM); and some old males (OM).

North

	YF	YF	YF	YF	OF	OF	OF	OF
	YF	YF	OF	YF	OF	OF	YF	OF
	YF	YM	OM	YF	OF	OM	YM	OF
West	YF	YF	YF	YF	OF	OF	OF	OF
	YM	YM	YM	YM	OM	OM	OM	OM
	YM	YM	OM	YM	OM	OM	YM	OM
	YM	YF	OF	YM	OM	OF	YF	OM
	YM	YM	YM	YM	OM	OM	OM	OM

East

South

Figure 2. A field of young and old males and females.

Suppose that you walk into this room looking for someone of your own age with whom to talk; if so, you would pay attention primarily to the east and west halves of the room because the old people are mostly in the east half and the young people in the west half. That is, you would pay attention primarily to the "east-west dimension." On the other hand, if your chief interest was to find someone of the opposite sex (whichever your own), you would pay attention primarily to the north and south halves of the room -- the "north-south dimension."

Suppose you were in one corner (any corner) of the room with a friend and he said, "I think I will look for some people more interesting than this bunch." In order to predict the direction in which he would stroll away, you would have to know the dimension by which he judged interestingness. But you might want to be helpful to your friend and you might suggest to him one or two persons with whom he would like to converse. If you took it for granted that he would move in the same direction you would move and if you were right in this assumption, then he would find your suggestions to be good ones. If you were wrong about your assumption -- if your "cognitive structure" about the interestingness of the people in the room was different from his -- then he would not enjoy your suggestions.

You and your friend would not need to prefer the same kind of conversationalists in order to comprehend the preferences of each other. If you were twenty years old and he were fifty, you might suggest to him that he strike up a conversation with some of the people in the east half of the room; even though you might yourself prefer to talk with young people, you might easily accept the idea that he would prefer to talk with older people. But you would both be using the east-west dimension as a basis for understanding the preferences of the other person.

We can just as well think of Figure 2 as being a field of statements about the realm of psychology as covered by a course in college. In getting ready for his experiment, Runkel constructed statements about the realm of psychology which could be imagined to be scattered over a field similar to that of Figure 2 (but no doubt having more than two dimensions). From the preferences among five statements expressed by students and instructors, the rank order of each person's preferences was worked out. The analogy here would be walking through the room, making judgments about whether one person or another was the more interesting conversationalist. You could very well end by rank ordering quite a number of the persons from the most to least interesting.

By using a geometric model (Coombs, 1964) it was possible to estimate whether, on the one hand, a teacher and his student were probably judging the statements about psychology on the same dimensions or, on the other hand, whether they were using different dimensions. If the instructor and student were basing their preferences among the

statements on the same dimension, this was a rough index of their "cognitive similarity" about psychology; if they were using different dimensions, this indicated cognitive dissimilarity.

Qualities of statements about psychology are not at all as easy to perceive as age and sex of human beings in a room. It is not easy to discern the dimensions of preference of another person concerning complicated matters such as opinions about psychological topics. The hypothesis in the experiment was that students who showed cognitive similarities to their instructors in regard to the statements would be better able to catch on to the preferences of their instructors about such statements, while students with cognitive structures dissimilar to those of their instructors would have a harder time anticipating the statements their instructors would prefer. Consequently, the prediction was that the "cognitively similar" students would obtain higher grades on quizzes written and graded by their instructors than would the "cognitively dissimilar" students.

The results computed for those subjects who were stable in their opinions (both in respect to their instructors and over the time period of a semester) supported the prediction and are summarized in the table. Because grading is different in level and range from class to class, the quiz scores were converted to "standard" scores within each class; that is, they were recomputed so that the standard deviation within each class became the unit for scoring. These standard scores are the "z-scores" mentioned in Table 3 below. The mean z-score for students with cognitive structures similar to those of their instructors was significantly higher ($P<.05$) than the mean for students with cognitive structures dissimilar from their instructors.

Table 3. Difference between z-scores on quizzes for students whose cognitive structure about psychology was (a) similar to that of their instructor and for those whose cognitive structure was (b) dissimilar to that of their instructor.

	(a) Similar	(b) Dissimilar
Top z-score	2.77	1.74
Mean z-score	0.60	-0.25
Lowest z-score	-1.16	-2.56
Standard deviation	1.38	1.17
Number of students	17	19

A number of common causes of differences between quiz scores were examined in this experiment by looking futher into the data. No evidence was found to cast doubt upon the hypothesis concerning cognitive similarity.

-- from T. M. Newcomb, R. H. Turner, and P. E. Converse, Social psychology: the study of human interaction. New York: Holt, Rinehart, Winston, 1965. Pp. 191-193.

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